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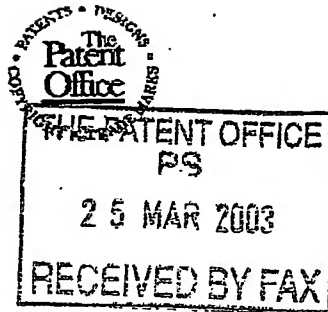
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1/77

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1. Your reference

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25MAR03 E794977-1 D10002
P01/7700 0.00-0306821.0

2. Patent application number
(The Patent Office will fill in this part)

0306821.0

25 MAR 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Specialised Petroleum Services Group Limited
Arnhall Business Park
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ABERDEEN
AB32 6TQ

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

08460784002
~~08460784002~~

4. Title of the invention

Dual Function Cleaning Tool

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Kennedys Patent Agency Limited
Queens House, Floor 5
29 St Vincent Place
G1 2DT

Patents ADP number (if you know it)

08058240002 ✓

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Country

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Date of filing
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if

Yes

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b) there is an inventor who is not named as an applicant, or
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11.

I/We request the grant of a patent on the basis of this application.

Signature

Date 25 March 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

David Kennedy - 0141 226 6826

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1 DUAL FUNCTION CLEANING TOOL

2

3 The present invention relates to downhole cleaning tools
4 for use in oil and gas wells and in particular, though
5 not exclusively, to a dual function cleaning tool adapted
6 for cleaning a polished bore receptacle (PBR) and
7 neighbouring casing on the same trip as setting a liner
8 including the PBR.

9

10 When a liner is cemented into casing located in a well
11 bore, the PBR located at the top of the liner together
12 with that part of the casing immediately above the PBR
13 (herein referred to as the neighbouring casing) are
14 susceptible to the influx of cement due to over
15 displacement when the cement is pumped through the drill
16 string and liner setting tool. Further when the drill
17 string and setting tool are removed from the liner,
18 cement and other debris located between the drill string
19 and casing will fall back into the PBR and adhere to the
20 neighbouring casing.

21

22 As the next stage requires the insertion of a sealing
23 assembly into the liner, the PBR requires to have a

1 smooth cylindrical inner bore on which an effective seal
2 can be made. Additionally, the inner bore of the
3 neighbouring casing is used to seal against a packer if a
4 liner top packer is inserted, and thus requires to
5 provide a smooth uniform cylindrical surface just above
6 the PBR.

7
8 Consequently the presence of cement and debris at the PBR
9 and/or the neighbouring casing provides a major problem
10 in ensuring a successful seal. In order to overcome this
11 problem, cleaning tools are typically run into the well
12 bore to clean the PBR and the neighbouring casing. A trip
13 is typically made to clean the PBR and a second trip is
14 typically needed to clean the casing. Each trip into a
15 well bore is both costly and time consuming.

16
17 Due to the decrease in inner bore diameter from the
18 casing to the PBR, a single trip cannot be made into the
19 well with a cleaning tool of a fixed diameter to clean
20 both the PBR and casing. Cleaning tools with cleaning
21 elements which are biased radially outwards such as that
22 disclosed in US 4,189,000 to Best, are inappropriate as
23 the elements cannot be retracted at the point of entry to
24 the PBR. Thus these tools can only clean the casing.
25 Additionally as the cleaning elements are not located at
26 the ends of the widest diameter of the tool, the cleaning
27 elements cannot effectively access the neighbouring
28 casing due to its close proximity to the narrower PBR.

29
30 It is therefore an object of the present invention to
31 provide a cleaning tool which can provide the dual
32 function of cleaning both the PBR and neighbouring casing
33 on the same trip into a well bore.

1

2 It is a further object of at least one embodiment of the
3 present invention to provide a cleaning tool which can
4 provide the dual function of cleaning both the PBR and
5 neighbouring casing on the same trip as the liner is set.

6

7 It is a further object of at least one embodiment of the
8 present invention to provide a cleaning tool which can
9 effectively clean the inner bore of a PBR without
10 damaging its relatively delicate inner surface while
11 being able to effectively scrape the harder wearing inner
12 surface of the neighbouring casing to effectively clean
13 this also.

14

15 It is a yet further object of the present invention to
16 provide a method of cementing a liner which includes the
17 step of cleaning the PBR and neighbouring casing on
18 tripping out the liner setting tool.

19

20 According to a first aspect of the present invention
21 there is provided a cleaning tool for use on a work
22 string, the tool comprising a cylindrical body having an
23 axial bore running there through, a plurality of cleaning
24 elements mounted thereon and positioning means to move
25 the cleaning elements in relation to the body, and
26 wherein the elements are located eccentrically to the
27 axial bore.

28

29 Preferably the cleaning elements are scrapers. Preferably
30 also each element has an inner face and an outer face.
31 The outer face may include one or more blades as
32 scrapers. More preferably the cleaning element is

1 substantially rectangular in cross-section to provide a
2 first edge between a side and the outer face.

3

4 Preferably the plurality of elements are located in at
5 least one band around the circumference of the body.

6 Preferably also the elements of each band are spaced
7 equidistantly around the body.

8

9 Preferably each element is located in a recess of the

~~10 body. Preferably each recess is located longitudinally~~

11 on the body, eccentrically to the axial bore. Preferably
12 also each recess has a lip located at each longitudinal
13 end thereof. The lip will prevent the cleaning element
14 moving out of the recess.

15

16 Preferably the positioning means is a biasing means
17 located between an inner surface of the recess and the
18 inner face of the cleaning element. More preferably the
19 biasing means is a spring. The spring may be leaf, coiled
20 or conical as are known in the art. Preferably the spring
21 is held in compression, biasing the element away from the
22 body.

23

24 Preferably the outer face is curved. More preferably the
25 curvature of the outer face is greater than a curvature
26 of the cylindrical body.

27

28 Preferably the curvature of the outer faces of the
29 elements are selected such that in a first position
30 wherein the outer faces are proud of the body, the outer
31 faces define a cylindrical surface centralised to the
32 axial bore. Preferably also in a second position wherein
33 the outer faces are located outwardly of the first

5

1 position, the first edge of each element provides a
2 leading edge of a scraper.

3

4 Preferably the outer face comprises a material being
5 softer or more malleable than the material of a PBR. In
6 this way the PBR cannot be damaged during scraping. The
7 material of the outer face may be brass.

8

9 Preferably also the elements include a profiled end. The
10 profiled end may be tapered. In this way, they allow a
11 sleeve, such as a PBR, to move the elements inwards
12 towards the body if the tool is inserted into a PBR.
13 Alternatively, the profiled end may provide a stop. In
14 this way, the stop which may be a shoulder, prevents
15 movement of the tool into a PBR whose top overlaps the
16 stop.

17

18 According to a second aspect to the present invention
19 there is provided a method of cleaning a liner top, the
20 method comprising the steps;

21

22 (a) inserting a tool according to the first aspect into
23 a liner;

24 (b) running the tool and liner together into a well
25 bore;

26 (c) setting the liner at a casing in the well bore;

27 (d) rotating and/or reciprocating the tool to clean an
28 inner surface of a PBR on the liner with the
29 cleaning elements;

30 (e) pulling the tool from the PBR, so that the cleaning
31 elements move outwardly to contact neighbouring
32 casing at the liner top; and

6

1 (f) rotating and/or reciprocating the tool to clean an
2 inner surface of the neighbouring casing with the
3 leading edges of the cleaning elements.
4

5 The method may include the further step of tripping the
6 tool from the well bore.
7

8 The method may include the step of attaching the tool to
9 a liner setting tool, so that the tool is tripped out
10 with the setting tool. In this way the casing is cleaned
11 as the setting tool is tripped from the well.
12

13 Preferably the method further includes the step of
14 selecting the curvature of the outer faces to be no
15 greater than the curvature of the inner surface of the
16 PBR. In this way, at the first position, the curvature of
17 the outer faces substantially match the curvature of the
18 inner surface of the PBR.
19

20 Preferably also the method may include the step of
21 running the tool back into the PBR.
22

23 An embodiment of the present invention will now be
24 described, by way of example only, with reference to the
25 accompanying drawings of which:
26

27 Figure 1 is a part cross-sectional schematic view through
28 a cleaning tool according to an embodiment of the present
29 invention; and
30

31 Figure 2 is a cross-sectional schematic view through the
32 tool of Figure 1 at section AA.
33

7

1 Reference is initially made to Figure 1 of the drawings
2 which illustrates a cleaning tool, generally indicated by
3 reference numeral 10, according to an embodiment of the
4 present invention. Tool 10 comprises a cylindrical body
5 12 having an axial bore 14. At an upper end 16 of the
6 tool 10 is located a box section 18 for connection of the
7 tool 10 to a work string or a liner setting tool (not
8 shown). At a lower end 20 of the tool 10 is located a pin
9 section 22 for connection of the tool 10 onto a lower
10 section of work string or drill string (not shown).

11

12 Three cleaning elements 24 are arranged equidistantly
13 around the body 12. Each element 24 is located in a
14 recess 26. Each recess 26 is rectangular and arranged on
15 the body 12 to be eccentric with the centre 28 of the
16 bore 14. This is best seen with the aid of Figure 2. Each
17 recess 26 is offset from a radius drawn from the centre
18 28. Thus a back surface 38 of the recess 26 is not
19 perpendicular to a radius drawn from the centre 28,
20 through the centre of the surface 38, and to the surface
21 44 of the body 12.

22

23 Each element 24 is generally rectangular in cross-section
24 and includes inner face 30, an outer face 32, and
25 longitudinal sides 34, 36 respectively. Between the inner
26 face 30 and the back surface 38 of the recess 26 is
27 located a linear expander in the form of a leaf spring
28 40. Spring 40 is attached to the element 24 by a screw
29 42. The spring 40 is held in compression and thus biases
30 the element 24 away from the back surface 38 of the
31 recess 26. In this way the front face 32 of the element
32 24 protrudes from the outer surface 44 of the body 12.

33

1 At each longitudinal end 46a,b of the recess 26 is
2 located a lip 48a,b. Lip 48a,b comprises a ring 50a,b
3 threaded onto the body 12. Ring 50a,b is held in position
4 by a lock wire 52a,b as is known in the art. Thus when
5 the tool is rotated the rings 50a,b and hence the lips
6 48a,b remain in position over the ends 46a,b of the
7 recesses. The lips 46a,b limit the movement of the
8 elements 24 away from the back surfaces 38 of the
9 recesses 26. By this limitation on movement, the springs
10 40 are always held in compression.

11
12 The outer face 32 of each element 24 comprises three
13 sections 54,56,58. Outer sections 54,56 taper towards the
14 surface 44 of the body 12 from an inner raised section
15 56. Inner section 56 is a scraper. The surface of section
16 56 comprises a blade, but alternatively could comprise a
17 milling surface. The element 24 is made of brass.
18 Alternatively only the middle section 56 could be made of
19 brass, mounted on a base plate comprising the other
20 sections 54,58 and the inner face 30. The outer face 32
21 is curved in the plane perpendicular to the axial bore
22 14. The curvature of the outer face does not match the
23 curvature of the surface 44 of the body 12 and is
24 unbalanced on the face 32. In this way a leading edge 60
25 is formed between the outer face 32 and a side 34 of the
26 element 24.

27

28 As can be seen with the aid of Figure 2, when the
29 elements 24b,c sit proud of the surface 44 of the body 12
30 at a first position, each outer face 32 lies on a circle
31 62 having a centre, at the centre 28 of the bore 14. As
32 is illustrated by the element 24a, in Figure 2, once the
33 face 32 is in any other position except the first, the

1 leading edge is presented as the point furthest from the
2 body 12.

3

4 In use, tool 10 is preferably attached to a liner setting
5 tool (not shown). The tool 10 is mounted ahead of the
6 setting tool on a drill string. The curvature of the
7 faces 32 are selected to be no greater than the curvature
8 of the inner surface 64 of the PBR 66 intended to be
9 cleaned. Ideally, as shown in Figure 2, surface 64
10 matches the circle 62 defined by the faces 32.

11

12 The tool 10 is inserted in the PBR 66 of the liner to be
13 set in casing 68. The tapered section 58, of the elements
14 24 allow the elements 24 to compress into the recesses
15 26. The tool 10 can then slide into the PBR 66 and be
16 held in place by the faces 32 being biased against the
17 inner surface 64 of the PBR 66. As the faces 32 comprise
18 of brass, which is a softer material than the steel
19 typically used for the PBR 66, the elements 24 will not
20 damage the smooth surface 64 of the PBR 66. With the tool
21 10 located in the PBR 66, the liner is run in the well
22 and set using the setting tool as is known in the art.
23 Cement can be pumped through the bore 14 during the
24 cementing process to set the liner.

25

26 Once the liner is set, the work string is rotated and or
27 reciprocated to allow the faces 32 to clean the inner
28 surface 64 of the PBR 66 to remove any debris or cement
29 which may have accumulated. As the faces 32 are of a
30 softer material than the material of the PBR 66 and the
31 curvatures are similar, the leading edges 60 sweep over
32 the surface 64 providing a polishing action so that the
33 surface 64 is left smooth.

10

1
2 Tool 10 is then withdrawn from the PBR 66 on the work
3 string. As the elements are freed from the PBR 66, they
4 will move away from the body 12 under the action of the
5 springs 40 and the faces 32 will now contact the inner
6 surface 70 of the neighbouring casing 68. As the
7 curvature of the faces 32 does not match the curvature of
8 the inner surface 68, the leading edge 60 will contact
9 the surface 68. Rotation and/or reciprocation of the tool
10 10 will cause the edge 60 to scrape the surface 68 and
11 thereby clean any debris or cement which rests thereon.
12 This cleaning action is more aggressive than that used in
13 the PBR 66. The casing 68 is thereby cleaned as the tool
14 10 is withdrawn from the well bore.

15
16 As the elements 24 extend from the body 12, the elements
17 24 can clean the neighbouring casing close to the PBR.
18 This is particularly useful as liner top packers are
19 generally set within two feet (50 cm) of the top 72 of
20 the PBR 66 and the cleaning action therefore provides a
21 good sealing surface on which to set the packer.

22
23 Any wear of the leading edge 60 will merely cause it to
24 self-sharpen by virtue of the curvature of the face 32
25 always meeting the side 34 at an edge.

26
27 In a further embodiment of the present invention the
28 tapered sections 54, 58 can be replaced by faces arranged
29 perpendicular to the axial bore 14. In use, the tool of
30 this embodiment can be used to provide a stop at the top
31 72 of the PBR 66. In this way the tool 10 cannot be
32 pushed back inside the PBR 66 and so can be used as a
33 packer actuator sub to set a liner top packer.

11

1

2 A principal advantage of the present invention is that it
3 provides tool which can clean both the PBR and
4 particularly, the neighbouring casing, on the same trip
5 as a liner is set.

6

7 A further advantage of the present invention is that it
8 provides a tool with the dual function of providing a
9 delicate cleaning action on the smooth sealing surface of
10 the PBR and a more aggressive cleaning action on the
11 inner surface of the casing.

12

13 Modifications may be made to the invention herein
14 intended without departing from the scope thereof. For
15 example, Though scrapers have been illustrated as the
16 cleaning elements bristles could also be placed on the
17 outer faces. The number of elements could be varied and
18 more rows of elements could be mounted on the tool.
19 Additionally, though movement of the cleaning elements is
20 provided by a spring, other means such as using hydraulic
21 pressure against the inner face 30 could be used to move
22 the cleaning elements outwards from the tool body.

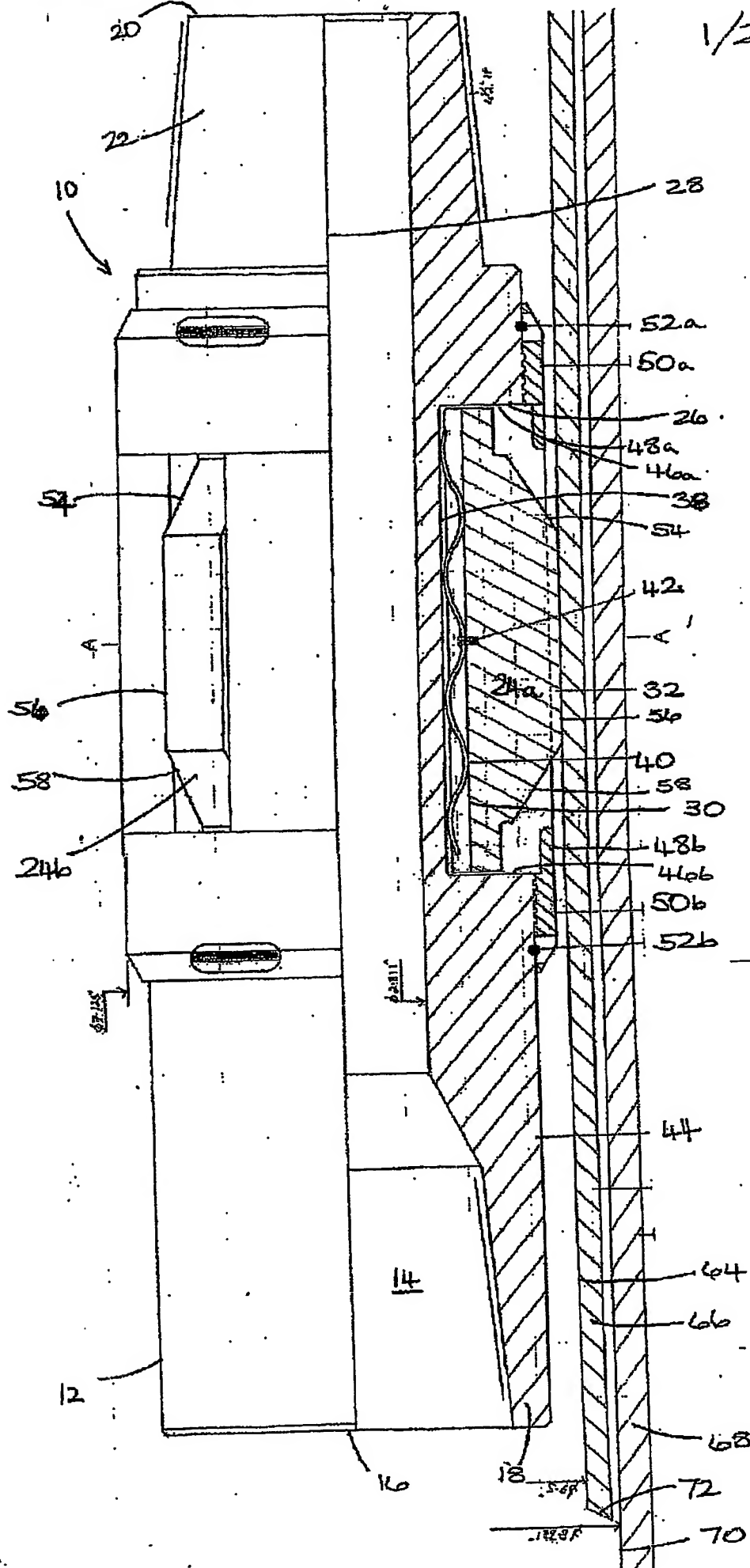


Figure 1

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